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Moisture Conditioning of Seed Cotton in Ginning as Related to Fiber Quality and Spinning Performance

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INTRODUCTION

Damp seed cotton is generally dried early in the ginning process to eliminate rough preparation and to improve its cleaning and extracting. Most modern cleaning and extracting equipment operates more effectively when the fiber moisture content is 5 percent or lower.[1] Industry, therefore, usually dries the seed cotton to this range to obtain maximum cleaning and grade. However, results from ginning research indicate that if the fibers of the seed cotton entering the gin stand are in the low moisture range, fiber quality will be lowered.[2] This lower quality occurs regardless of whether the seed cotton is dried artificially in the gin or naturally as a result of very dry weather during harvesting and ginning.

Research also indicates that if the fiber moisture content is increased to the 6- to 8-percent level before the cotton enters the gin stand, damage to fiber quality will be reduced, if not eliminated. The principal quality change that occurs when cotton is very dry when ginned is the reduction of fiber length. Experiments have shown that increasing the moisture content at the lint slide does not eliminate the occurrence of short fibers in ginned lint.[3]

Industry has developed two methods of increasing the moisture content of cotton during ginning—the spray method and the vapor method. In the spray method, a mist of water is sprayed on the seed cotton and the cotton held until the moisture is absorbed by the fibers before it is metered into the gin stands. In the vapor method, the seed cotton is held in warm air of very high relative humidity until the moisture is absorbed by the fibers before being metered into the gin stands.

The objectives of this research were to determine the effects on the ginning and spinning performance and fiber and yarn quality of the two methods of seed cotton moisture conditioning by adding or restoring moisture to dry fibers after cleaning but before ginning.

EXPERIMENTAL PROCEDURES

Cottons Used

The research was conducted over 2 crop years, 1961 and 1962. In 1961, cotton tested was a Blightmaster variety produced on the Texas Experiment Substation No. 8 near Lubbock, Tex. It was harvested after frost on December 26, 1961, by machine stripping once-over and stored indoors until hauled to the Ginning Laboratory at Mesilla Park, N. Mex. Approximately 26,000 pounds of cotton was hauled in four trips, the first beginning on January 5, 1962, and ending on January 15. Ginning began on January 8 and ended January 18. The delay between harvesting and ginning was due to inclement weather.

The cotton used in 1962 was Deltapine Smooth Leaf variety grown on the University of Arizona Experiment Station farm at Marana, Ariz. It was harvested before frost on October 30, 1962, with a spindle-type picker. No spindle-moistening agent was used during harvesting to eliminate any possibility of its affecting the moisture treatments during ginning. About 11,100 pounds of cotton was harvested and immediately hauled to the Ginning Laboratory. Ginning began on November 1 and ended on November 5.

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[1] Griffin, A. C., and Merkel, C. M. moisture content of seed cotton in relation to cleaning and ginning efficiency and lint quality. U.S. Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering Report, 16 pp. September 1953. (Out of print.)

[2] Moore, V. P., and Griffin, Clyde. the relationship of moisture to cotton quality preservation at gins. U.S. Dept. Agr. ARS 42–105, 12 pp. December 1964.

[3] Griffin, A. C., and Harrell, E. A. effects of moisture added at lint slide on lint quality and bale weight in humid cotton-growing areas. U.S. Dept. Agr. Prod. Res. Rpt. 14, 16 pp. August 1957.

Ginning

The experimental variable was the fiber moisture content during the separation of the fibers from the seeds in the gin stand. This moisture content depended upon the method of drying, the method of adding or restoring moisture in the ginning treatments, and the beginning or wagon moisture contents. Since taking samples from, or making moisture measurements within, the roll box was not practical, the fiber moisture was estimated with oven-drying moisture determinations on samples of lint taken from the batt entering the first lint cleaner. The distance from the outlet of the gin to the lint cleaner condenser screen was 10 feet. During the 1962 ginning, a second method was also used to determine the fiber moisture. Samples of seed cotton were taken from the feeder apron and ginned immediately on a small roller gin. This roller-ginned lint, then, was analyzed for moisture content. The differences in moisture content of the lint between the two methods were small.

Seven ginning treatments were used in 1961 and four in 1962. Each treatment was replicated three times, and the ginning order of the treatments was randomized within each replication both years.

The same ginning equipment setup was used for every treatment both seasons. This setup consisted of a tower drier (18 shelves), 12 cylinders of seed cotton cleaning, a bur machine, an extractor-feeder, an 80-saw gin stand (12-inch-diameter saws), and two saw-type lint cleaners in series. The ginning equipment setups and moisture-conditioning operations that were used in both years for all of the treatments are shown in table 1.

Throughout the ginning processes, samples of seed cotton and lint were taken at several locations and measured. These sampling locations and type of samples are given in table 2.

All bales of ginned lint were shipped to the U.S. Department of Agriculture Pilot Spinning Laboratory at Clemson, S.C., for fiber and spinning quality measurements.

1961 Tests

Seven ginning treatments were tested in 1961. They were classified as follows:

Dried treatments—seed cotton passed through an 18-shelf tower drier using an inlet drying temperature of 280° F.:

1. Dried and cleaned, no moisture restored during ginning.
2. Dried and cleaned, moisture restored by the spray method before the extractor-feeder.
3. Dried and cleaned, moisture restored by the vapor method in the extractor-feeder.

Not dried treatments—seed cotton passed through an 18-shelf tower drier with ambient air:

4. Not dried, cleaned, no moisure added during ginning.
5. Not dried, cleaned and moisture added by the spray method before the extractor-feeder.
6. Not dried, cleaned and moisture added by the vapor method in the extractor-feeder.
7. Not dried, cleaned and moisture added by the vapor method in the chute used for spray application, distributor, and extractor-feeder.

The spray method of moisture conditioning consisted of spraying water on the seed cotton as it fell through a 50-inch-high vertical chute located below a seed cotton separator over the distributor. Three spray nozzles were installed on one side of the chute and were remotely operated by an electric solenoid valve that was connected to the water mains. The water pressure was 55 p.s.i. No wetting agent was used. The treated seed cotton passed into the overflow bin where it was stored for 30 minutes to allow the fibers to absorb the water, routed back throught a separator, the distributor, the extractor-feeder, and then, ginned.

In the vapor method, a commercial air humidifier furnished about 4,000 cubic feet per minute (c.f.m.) of air at 85 to 95 percent relative humidity at 100° to 110° F. The one extractor-feeder required only 900 c.f.m. of humid air, so the rest was discharged to the outside. For the regular vapor treatment, the seed cotton was exposed to the humid air for the 3 to 4 seconds that it took the cotton to pass through the extractor-feeder. A second vapor treatment was used to provide a longer exposure time by blowing additional humid air into the vertical chute over the distributor and into the section of distributor from the chute to the extractor-feeder (about 6 feet). This treatment was used only with the cotton not dried. The piping arrangement for furnishing humid air to the extractor-feeder and the vertical chute is shown in figure 1.

An average of 1,239 pounds of stripper-harvested material was used for each of the 21 test lots (7 treatments times 3 replications), yielding an average of 284 pounds of lint, or giving a turnout of 22.9 percent.

1962 Tests

Four ginning treatments tested in 1962 were:

1. Dried, no moisture restored during ginning.
2. Dried and cleaned and moisture restored before the extractor-feeder by the spray method.
3. Dried and cleaned and moisture restored in the extractor-feeder by the vapor method.
4. Not dried, no moisture added during ginning.

Some changes were made in the spray equipment after the 1961 season. A rectangular spray unit containing a set of feed rolls was installed below the distributor. Eight spray nozzles of smaller capacity than those used in 1961 were substituted

TABLE 1.—*Gin machinery setups and moisture-conditioning operations used for 7 ginning treatments, seed cotton moisture conditioning study, 1961 and 1962*

Ginning machinery and seed cotton moisture conditioning sequence [1]	Ginning treatments [2]						
	Dried			Not dried			
	No moisture restored	Moisture restored by—		No moisture added	Moisture added by—		
		Spray	Vapor		Spray	Vapor	Vapor [3]
1961 crop, machine-stripped Blightmaster, Lubbock, Tex.:							
1st separator (unloading)	x	x	x	x	x	x	x
Tower drier (18-shelves)	x	x	x	x	x	x	x
Drier inlet air temperature, °F	280	280	280	66	66	72	68
1st 6-cylinder cleaner	x	x	x	x	x	x	x
Bur machine	x	x	x	x	x	x	x
2d 6-cylinder cleaner	x	x	x	x	x	x	x
2d separator	x	x	x	x	x	x	x
Moisture conditioning chute, water sprays	off	on	off	off	on	off	off
Distributor	x	x	x	x	x	x	x
Cotton given 30-minute storage then returned through 2d separator and distributor	0	x	0	0	x	0	0
Extractor-feeder	x	x	x	x	x	x	x
Humid air blown into extractor-feeder	0	0	x	0	0	x	x
Humid air blown into conditioning chute and distributor	0	0	0	0	0	0	x
80-saw gin stand (12-inch diameter)	x	x	x	x	x	x	x
1st saw-type lint cleaner	x	x	x	x	x	x	x
2d saw-type lint cleaner	x	x	x	x	x	x	x
Press condenser	x	x	x	x	x	x	x
Bale press	x	x	x	x	x	x	x
1962 crop, machine-picked DPL Smooth Leaf, Marana, Ariz.:							
1st separator (unloading)	x	x	x	x			
Tower drier (18-shelves)	x	x	x	x			
Drier inlet air temperature, °F	300	300	300	86			
1st 6-cylinder cleaner	x	x	x	x			
Bur machine	x	x	x	x			
2d 6-cylinder cleaner	x	x	x	x			
2d separator	x	x	x	x	Treatments omitted in 1962 season.		
Distributor	x	x	x	x			
Cotton passed through water spray unit, held 30 minutes then returned through 2d separator and distributor	0	x	0	0			
Extractor-feeder	x	x	x	x			
Humid air blown into extractor-feeder	0	0	x	0			
80-saw gin stand (12-inch diameter)	x	x	x	x			
1st saw-type lint cleaner	x	x	x	x			
2d saw-type lint cleaner	x	x	x	x			
Press condenser	x	x	x	x			
Bale press	x	x	x	x			

[1] x indicates equipment or operation used; 0 indicates operation not used.

[2] Dried treatments: Seed cotton passed through an 18-shelf tower drier using an inlet drying temperature of 280° F.; not dried; seed cotton passed through an 18-shelf tower drier with ambient air.

[3] Long exposure.

LE 2.—*Laboratory gin sampling information, ed cotton moisture conditioning study, 1961 d 1962*

pe of sample, sampling location, and measurement	Number of samples per treatment lot	
	1961	1962
cotton:		
gon:		
Moisture content	3	3
Fiber moisture content [1]	0	3
Foreign matter content	2	2
tlet of 2d 6-cylinder cleaner:		
Moisture content	3	3
Fiber moisture content [1]	0	3
Foreign matter content	2	2
eder apron:		
Moisture content	3	3
Fiber moisture content [1]	0	3
Foreign matter content	2	2
ed lint:		
t entering 1st lint cleaner:		
Moisture content	3	3
Foreign matter content	1	1
Fiber analysis	1	1
t entering 2d lint cleaner:		
Moisture content	3	3
Foreign matter content	1	1
Fiber analysis	1	1
t slide:		
Moisture content	3	3
Foreign matter content	1	1
Fiber analysis	1	1

mple of seed cotton roller-ginned; moisture deter- ion made on ginned lint.

he three formerly used. These nozzles were ged four on each side opposite each other to ibute the moisture more uniformly. The seed n was fed from the distributor into the feed from there it fell through the water spray mobile boxes and was stored for 30 minutes e ginning. Figure 2 shows this unit in tion.

e vapor treatment equipment was not changed the 1961 season except that humid air was only in the extractor-feeder. An average of .f.m. of air at 112° F. and 97 percent relative dity was blown into the extractor-feeder.

average of 900 pounds of seed cotton was for each of the 12 test lots (4 treatments times lications), yielding an average net lint weight 9 pounds, a turnout of 35.4 percent.

Spinning Procedures

At the Spinning Laboratory, standard processing procedures were used in opening, in picking, and through roving for the test cottons. No card crusher rolls were used.

In the spinning process, 30s warp yarn with a 4.49 twist multiplier was spun with a spindle speed of 11,250 revolutions per minute (r.p.m.) from the Blightmaster cotton. From the Deltapine Smooth Leaf cotton, 40s yarn with a 4.09 twist multiplier was spun with a spindle speed of 10,000 r.p.m. New travelers were used on each doff, and the spinning frames were allowed to run for 30 minutes before an ends down count was made. This period served as a break-in period for the travelers and also produced yarn for sizing so that the correct draft gear could be determined.

A spinning test on each lot consisted of running a full doff of yarn. The 30s yarn required 6 hours per doff of continuous frame operation, or 6,048 spindle hours, while the 40s yarn required 10½ hours per doff, or 10,584 spindle hours. Ends down were recorded on 15-minute cycles, and these data were combined so that ends down per 1,000 spindle hours (EDMSH) could be determined.

Each lot was processed under controlled conditions of 75° F. and 55 percent relative humidity in both the carding and the spinning rooms.

RESULTS

Ginning

The results of the measurements made during ginning and on samples taken during ginning are summarized in table 3 for 1961 and in table 4 for 1962. The results of measurements made on samples of lint taken from the bales at the Spinning Laboratory are given in tables 5 and 6 for the 2 years. Each entry is the mean for three replications of the listed treatment.

The treatment means were tested for statistically significant differences by analysis of variance, and the level of significance is given as part of the tabulated results. No entry indicates that the analysis was not performed on that particular measurement.

1961 Tests

The seed cotton was fairly uniform with the moisture contents of wagon seed cotton, averaging 6.1 percent, and the wagon foreign matter content, averaging 29 percent. Changes in the moisture content had little effect on the cleaning efficiencies of seed cotton and lint. The overall seed cotton cleaning efficiency was 80 percent while that of the two lint cleaners in series was 70 percent.

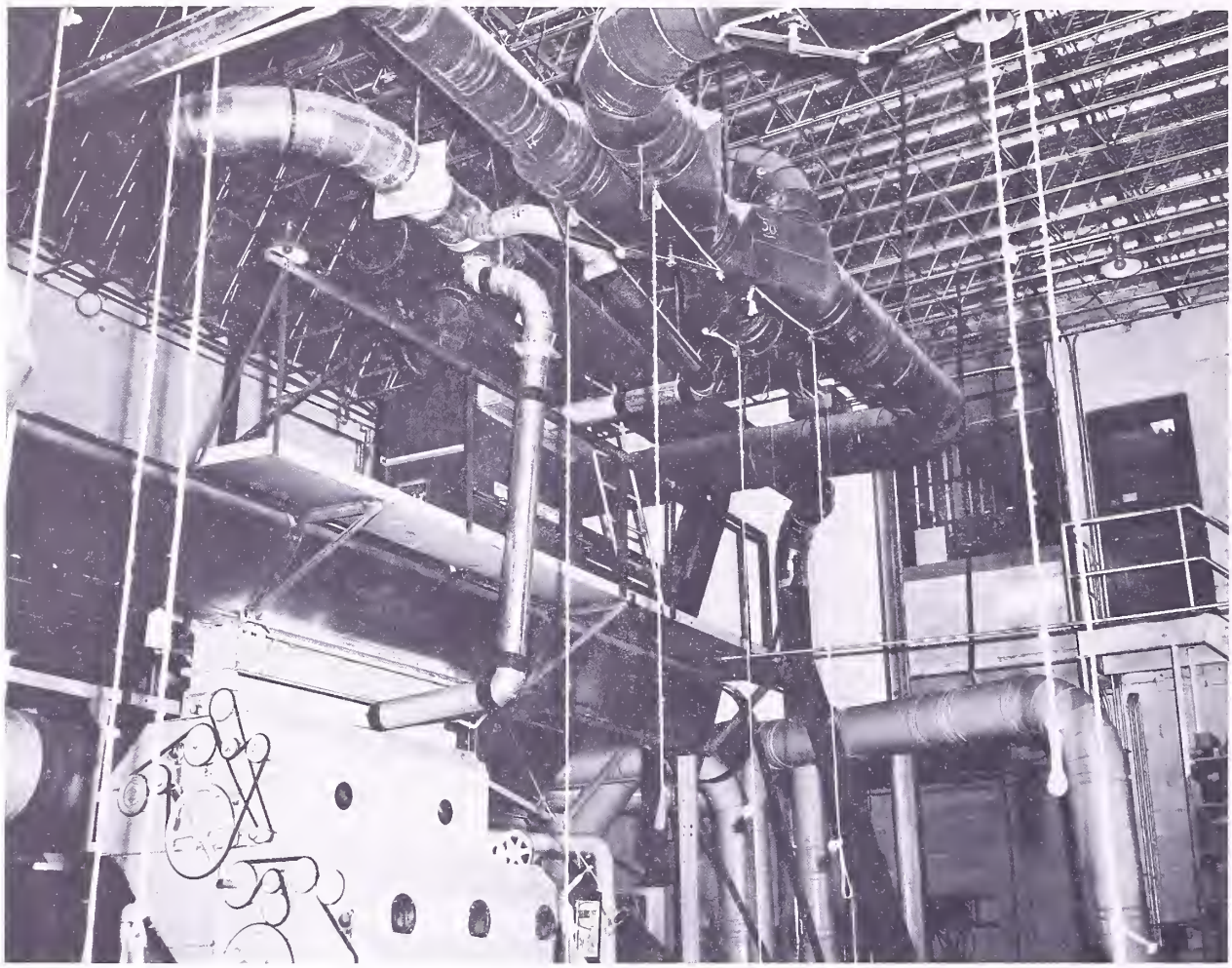

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FIGURE 1.—Piping arrangement used to furnish humid air to the extractor-feeder and to the seed cotton chute over the distributor for the vapor method of seed cotton moisture conditioning.

The treatments produced highly significant differences in the moisture contents at all locations beyond the wagon. The moisture content of the lint entering the first lint cleaner ranged from a low of 3.2 percent for the dried check to a high of 8.8 percent for the not-dried-spray treatment.

The number of neps remained about the same for all treatments for no lint cleaning and for the two lint cleaners in series. There was a significant difference among treatments after one lint cleaner but whether this was due to the moisture treatment is doubtful. The average number of neps before lint cleaning was 20. This number increased to 27, a 35-percent increase, after one lint cleaner, and to 31, an overall increase of 55 percent, for two lint cleaners.

All treatments yielded lint of the same grade, Strict Low Middling (table 5).

Differences were significant, most of them at the 99-percent level, among treatments for all measurements of length. The fiber length correlated positively with moisture content while there was a negative correlation between short fibers and moisture. No significant differences were found in Pressley strength or micronaire fineness due to ginning treatments.

After the lint had been cleaned with a Shirley Analyzer, colorimeter measurements were made to determine if any of the treatments affected the color characteristics of the lint. No significant differences were found.

1962 Tests

The seed cotton was slightly irregular in both moisture and foreign matter contents in 1962 than in 1961 (table 4). The wagon moisture content

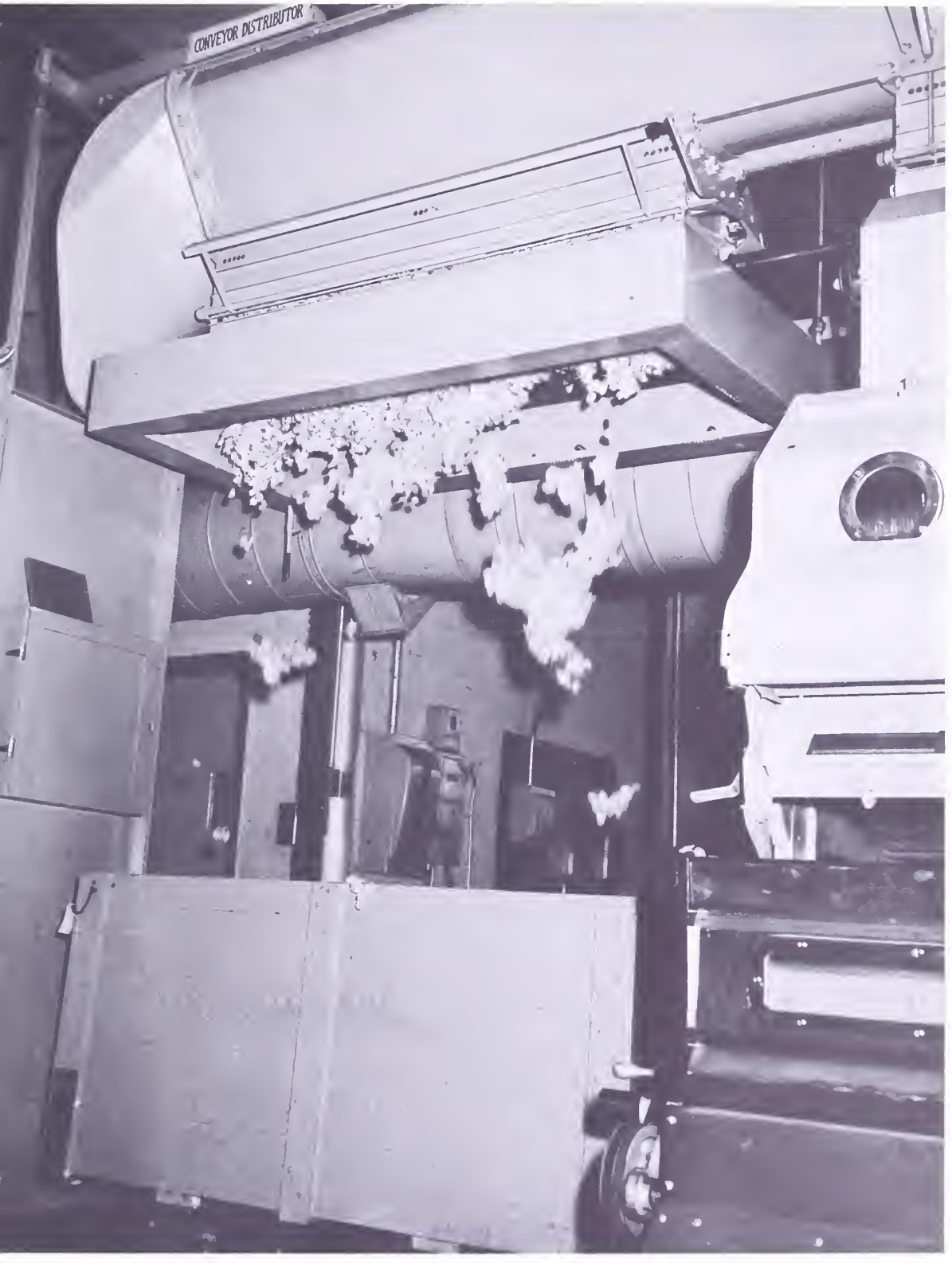

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FIGURE 2.—Equipment for spraying water on seed cotton.

TABLE 3.—*Mean values of measurements on Blightmaster cotton grown in Lubbock, Tex., in 1961, stripped after frost, for 7 specified ginning treatments*

Measurement	Ginning treatment [1]							Significance level [3]
	Dried			Not dried				
	No moisture restored	Moisture restored by—		No moisture added	Moisture added by—			
		Spray	Vapor		Spray	Vapor	Vapor [2]	
Gin room air temperature, ° *F*	54	57	61	56	55	59	56	
Gin room air relative humidity, *percent*	33	39	35	32	36	39	34	
Tower drier inlet air temperature, ° *F*	280	280	280	66	66	72	68	
Tower drier outlet air temperature, ° *F*	230	234	234	65	64	69	67	
Moisture content of seed cotton:								
Wagon, *percent*	6.0	6.2	6.0	6.1	6.4	6.2	5.9	NS
2d 6-cylinder cleaner outlet, *percent*	5.3	5.5	5.4	6.1	6.3	6.3	5.9	(**)
Feeder apron, *percent*	5.3	7.7	6.0	6.0	8.4	6.7	6.6	(**)
Moisture content of ginned lint:								
Entering 1st lint cleaner, *percent*	3.2	7.9	4.8	5.1	8.8	6.4	6.2	(**)
Entering 2d lint cleaner, *percent*	3.1	6.9	4.7	4.9	7.4	6.1	5.8	(**)
Lint slide, *percent*	3.0	6.4	4.4	4.9	6.7	5.9	5.5	(**)
Foreign matter contents of seed cotton:								
Wagon, *percent*	28.6	29.8	28.0	29.0	29.4	29.4	28.5	NS
2d 6-cylinder cleaner outlet, *percent*	11.7	14.0	12.0	13.4	15.9	15.6	15.6	(**)
Feeder apron, *percent*	6.0	7.8	6.0	8.8	7.6	9.0	7.9	(*)
Seed cotton cleaning:								
Trash removed/100 lb. clean cotton, *lb*	33.6	33.9	32.5	31.4	33.4	31.9	31.3	
Cleaning efficiency, *percent*	84	80	84	77	80	76	78	
Foreign matter contents of ginned lint:								
Entering 1st lint cleaner, *percent*	6.96	9.16	7.64	8.96	11.61	11.10	9.29	(**)
Entering 2d lint cleaner, *percent*	4.55	5.39	4.39	4.79	6.07	6.15	5.44	(**)
Lint slide, *percent*	2.35	3.30	2.51	2.61	3.56	3.27	2.87	NS
Lint cleaning:								
Trash removed/100 lb. clean lint, *lb*	5.1	6.7	5.7	7.2	9.4	9.1	7.3	
Cleaning efficiency, *percent*	68	66	69	73	72	73	71	
Neps in ginned lint: [4]								
Entering 1st lint cleaner, *No./100 sq. in*	19	22	20	21	22	19	21	NS
Entering 2d lint cleaner, *No./100 sq. in*	26	30	24	27	27	27	27	(*)
Lint slide, *No./100 sq. in*	29	31	30	32	31	32	32	NS

[1] See footnote 2, table 1, for description of ginning treatments.
[2] Long exposure.
[3] NS = not significant; * = significant at the 95-percent level; and ** = significant at the 99-percent level.
[4] Neps in web prepared on accessory to the mechanical fiber blender.

Measurement	Ginning treatment [1]				
	Dried			Not dried, no moisture added	Significance level [2]
	No moisture restored	Moisture restored by—			
		Spray	Vapor		
Gin room air temperature, ° *F*	78	73	79	75	
Gin room air relative humidity, *percent*	25	31	26	28	
Tower drier inlet air temperature, ° *F*	300	300	300	86	
Tower drier outlet air temperature, ° *F*	255	255	255	83	
Moisture content of seed cotton:					
Wagon, *percent*	6. 9	6. 7	6. 1	6. 2	NS
2d 6-cylinder cleaner outlet, *percent*	5. 4	5. 5	4. 8	6. 0	NS
Feeder apron, *percent*	5. 1	6. 8	5. 7	5. 8	(**)
Moisture content of roller ginned samples of seed cotton:					
Wagon, *percent*	4. 8	5. 0	4. 4	4. 6	NS
2d 6-cylinder cleaner outlet, *percent*	2. 6	2. 9	2. 5	4. 2	(**)
Feeder apron, *percent*	2. 6	5. 1	3. 9	4. 0	(**)
Moisture content of ginned lint:					
Entering 1st lint cleaner, *percent*	2. 4	5. 3	4. 0	4. 4	(**)
Entering 2d lint cleaner, *percent*	2. 4	4. 9	3. 8	4. 2	(**)
Lint slide, *percent*	2. 4	4. 8	3. 7	4. 2	(**)
Foreign matter contents of seed cotton:					
Wagon, *percent*	4. 6	4. 6	4. 1	4. 8	NS
2d 6-cylinder cleaner outlet, *percent*	1. 7	1. 7	1. 9	1. 5	NS
Feeder apron, *percent*	. 8	. 7	. 8	. 8	NS
Seed cotton cleaning:					
Trash removed/100 lbs. clean seed cotton, *lb*	4. 0	4. 1	3. 5	4. 2	
Cleaning efficiency, *percent*	84	84	80	83	
Foreign matter contents of ginned lint:					
Entering 1st lint cleaner, *percent*	1. 95	1. 82	1. 82	1. 88	NS
Entering 2d lint cleaner, *percent*	1. 13	1. 24	1. 12	1. 21	NS
Lint slide, *percent*	. 67	. 72	. 65	. 66	NS
Lint cleaning:					
Trash removed/100 lbs. clean lint, *lb*	1. 4	1. 0	1. 4	1. 4	
Cleaning efficiency, *percent*	52	47	56	56	
Neps in ginned lint: [3]					
Entering 1st lint cleaner, *No./100 sq. in. web*	14	13	13	14	NS
Entering 2d lint cleaner, *No./100 sq. in. web*	17	15	16	15	NS
Lint slide, *No./100 sq. in. web*	25	30	28	23	NS

[1] See footnote 2, table 1, for description of ginning treatments.
[2] NS=not significant; *=significant at the 95-percent level; and **=significant at the 99-percent level.
[3] Neps in web prepared on accessory to the mechanical fiber blender.

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TABLE 5.—*Effects of specified ginning treatments on fiber quality of Blightmaster cotton grown in Lubbock, Tex., stripped after frost in 1961*

Measurement	Ginning treatment [1]							Significance level [3]
	Dried			Not dried				
	No moisture restored	Moisture restored by—		No moisture added	Moisture added by—			
		Spray	Vapor		Spray	Vapor	Vapor [2]	
Moisture content of lint entering 1st lint cleaner, *percent*	3.2	7.9	4.8	5.1	8.8	6.4	6.2	(**)
Classification:								
Grade, index	94	94	94	94	94	94	94	NS
Designation [4]	SLM	SLM	SLM	SLM	SLM	SLM	SLM	-------
Staple length, 1/32 *inch*	30	32	31	31	31	31	32	(**)
Fibrograph:								
Upper half mean length, *inch*	.86	.91	.90	.89	.92	.91	.92	(**)
Mean length, *inch*	.65	.70	.69	.68	.73	.70	.71	(**)
Uniformity ratio, *percent*	75	77	77	77	78	77	78	(*)
Suter-Webb array:								
Upper quartile length, *inch*	.98	1.03	1.01	1.01	1.04	1.04	1.03	(**)
Mean length, *inch*	.77	.83	.82	.80	.85	.84	.84	(**)
Coefficient of variability, *percent*	38	33	33	35	32	33	32	(**)
Fibers shorter than ½ inch, *percent*	19.5	13.6	14.1	16.2	12.2	13.0	12.9	(**)
Pressley strength:								
0 gage, *grams per tex*	33.4	33.4	32.6	33.5	34.0	33.9	33.0	NS
1/8-inch gage, *grams per tex*	18.1	18.9	18.7	18.8	18.9	19.2	19.0	NS
Micronaire fineness, *reading*	3.2	3.2	3.2	3.2	3.2	3.2	3.2	NS
Color after foreign matter removed with Shirley Analyzer:								
Reflectance, *Rd* [5]	73.9	73.3	73.8	74.4	73.7	74.2	74.1	NS
Yellowness, $+b$ [6]	8.9	8.8	8.8	8.7	8.7	8.7	8.7	NS

[1] See footnote 2, table 1, for description of ginning treatments.
[2] Long exposure.
[3] NS=not significant; *=significant at the 95-percent level; and **=significant at the 99-percent level.
[4] SLM=Strict Low Middling.
[5] Percent reflectance.
[6] Percent yellowness.

Measurement	Ginning treatment [1]				
	Dried			Not dried, no moisture added	Significance level [2]
	No moisture restored	Moisture restored by—			
		Spray	Vapor		
Moisture content of lint entering 1st lint cleaner, *percent*	2.4	5.3	4.0	4.4	(**)
Classification:					
Grade, index	104	100	104	104	NS
Designation [3]	SM	M	SM	SM	----------
Staple length, 1/32 *inch*	33	34	33	33	NS
Fibrograph:					
Upper half mean length, *inch*	1.05	1.07	1.07	1.05	NS
Mean length, *inch*	.82	.85	.85	.83	NS
Uniformity ratio, *percent*	78	80	80	78	NS
Suter-Webb array:					
Upper quartile length, *inch*	1.18	1.21	1.21	1.18	(*)
Mean length, *inch*	.91	.95	.96	.91	(*)
Coefficient of variability, *percent*	37	35	34	37	NS
Fibers shorter than ½ inch, *percent*	15.3	12.4	12.3	15.5	(*)
Pressley strength:					
0 gage, *grams per tex*	39.5	39.2	38.9	38.7	NS
⅛ inch gage, *grams per tex*	22.0	21.9	21.8	21.9	NS
Micronaire fineness, *reading*	4.6	4.6	4.6	4.6	NS
Color after foreign matter removed with a Shirley Analyzer:					
Reflectance, *Rd* [4]	77.2	77.1	77.4	77.9	NS
Yellowness, $+b$ [5]	8.6	8.5	8.2	8.4	NS

[1] See footnote 2, table 1, for description of ginning treatments.
[2] NS=not significant; *=significant at the 95-percent level; **=significant at the 99-percent level.
[3] SM=Strict Middling; M=Middling.
[4] Percent reflectance.
[5] Percent yellowness.

averaged 6.5 percent while the foreign matter content averaged 4.5 percent.

The average seed cotton cleaning efficiency was about 83 percent. The lint cleaning efficiency for the two lint cleaners in series averaged 53 percent for all treatments; however, for the dried-plus-spray treatment, it was only 47 percent.

All treatments produced highly significant differences in fiber and lint moisture contents at all locations past the wagon. The lint moisture content at the entrance to the first lint cleaner ranged from 2.4 percent for the dried check to a high of 5.3 percent for the dried-spray treatment.

No significant differences occurred in neps due to moisture treatments, but the average nep count for all treatments increased with lint cleaning somewhat similar to the 1961 results.

Differences occurred in Classers' grade (table 6) with the highest moisture content treatment classed as Middling (M), while the other three were classed as Strict Middling (SM).

The effect of fiber moisture content on fiber length was not as pronounced as in 1961, but the same trend was obtained. Longer staple lengths and fewer short fibers were obtained in 1962 with the higher moisture content treatments.

The relationship between fiber moisture content at the time of ginning and resultant fiber length is shown for both years by the regression curves in figure 3. The regressions shown are for the moisture content of the lint on the lint slide which was generally slightly less than immediately after ginning due to drying by the conveying air. Positive linear correlation coefficients of 0.84 and 0.50 were obtained for 1961 and 1962, respectively.

There were no differences in either Pressley strength or micronaire fineness due to the moisture treatments.

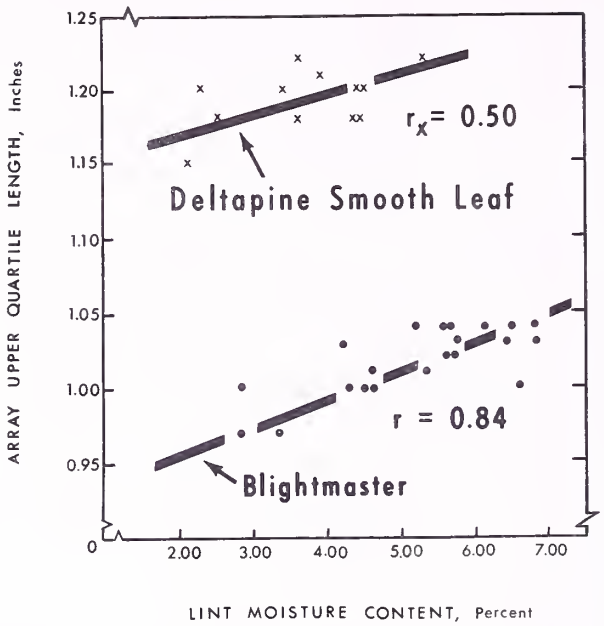

FIGURE 3.—Regression curves of the lint moisture measured on the lint slide and Suter-Webb array upper quartile length of the 1961 Blightmaster and the 1962 Deltapine Smooth Leaf cotton.

Card Sliver Measurements and Spinning Performance

The means for the measurements on card sliver samples and for the spinning properties of the three replications of each treatment are given in tables 7 (1961) and 8 (1962). The statistical level of significance calculated by analysis of variance is also given for each measurement.

Card Sliver

Differences among treatments for all fiber length measurements were highly significant in 1961 and not as significant in 1962, although the same trends were obtained.

There were no differences in Pressley strength or micronaire fineness due to ginning treatments in either year.

Spinning

Differences were significant among treatments in card waste and total picker and card waste with a slight trend of increased waste being associated with increased moisture during ginning in 1961, but this trend did not appear with the cleaner cotton in 1962.

Nep counts were slightly higher in the card web with the higher moisture content treatments in 1961 with a similar trend, but not as significant, in 1962.

There was a definite and highly significant trend towards higher yarn break factor with increasing moisture content during ginning in 1961, but this trend was not statistically evident in 1962.

The number of ends down per 1,000 spindle hours were highly significantly different for treatments in 1961 but erratic when compared with the moisture content at the time of ginning. The differences in ends down were not significant in 1962. These results could not be explained at the time of spinning, but later studies have shown that in-

Measurement	Ginning treatment [1]							Significance level [3]
	Dried			Not dried				
	No moisture restored	Moisture restored by—		No moisture added	Moisture added by—			
		Spray	Vapor		Spray	Vapor	Vapor [2]	
Moisture content of lint entering 1st lint cleaner, *percent*	3. 2	7. 9	4. 8	5. 1	8. 8	6. 4	6. 2	(**)
Card sliver:								
Fibrograph:								
Upper half mean length, *inch*	. 85	. 90	. 88	. 87	. 91	. 91	. 90	(**)
Mean length, *inch*	. 64	. 68	. 68	. 65	. 70	. 70	. 68	(**)
Uniformity ratio, *percent*	75	76	77	74	77	77	76	(**)
Suter-Webb array:								
Upper quartile length, *inch*	. 95	. 99	. 98	. 97	1. 01	1. 01	1. 00	(**)
Mean length, *inch*	. 73	. 79	. 78	. 75	. 81	. 79	. 79	(**)
Coefficient of variability, *percent*	39	35	36	37	35	36	35	(**)
Fibers shorter than ½-inch, *percent*	22. 3	17. 0	17. 4	20. 3	15. 8	17. 3	17. 1	(**)
Pressley strength:								
0 gage, *grams per tex*	33. 7	34. 5	34. 0	34. 0	33. 8	35. 0	34. 8	NS
⅛-inch gage, *grams per tex*	18. 2	18. 7	18. 2	18. 6	18. 6	18. 7	18. 4	NS
Micronaire fineness, *reading*	3. 3	3. 3	3. 3	3. 3	3. 3	3. 3	3. 3	NS
Spinning properties:								
Waste:								
Opening and picking waste, *percent*	1. 03	1. 15	. 90	1. 71	1. 33	1. 25	1. 16	NS
Card waste, *percent*	4. 88	4. 77	4. 37	4. 78	5. 34	5. 20	4. 88	(**)
Total picker and card waste, *percent*	5. 86	5. 87	5. 23	6. 40	6. 60	6. 39	5. 98	(*)
Neps of card web per 100 sq. in., *number*	13	18	17	15	18	18	18	(**)
Yarn size obtained, *number*	29. 7	30. 0	29. 8	29. 9	29. 6	29. 7	29. 6	NS
Break factor, *unit*	1, 439	1, 620	1, 600	1, 570	1, 669	1, 670	1, 655	(**)
Yarn appearance, *index*	97. 0	100. 0	100. 0	100. 0	97. 0	100. 0	100. 0	NS
Ends down per 1,000 spindle hours (corrected), *number*	93	106	67	91	206	125	109	(**)

[1] See footnote 2, table 1, for description of ginning treatments.
[2] Long exposure.
[3] NS=not significant; *=significant at the 95-percent level; **=significant at the 99-percent level.

TABLE 8.—*Effects of ginning treatments on card sliver measurements and spinning performance of Deltapine Smooth Leaf cotton grown in Marana, Ariz., mechanically picked in 1962, seed cotton moisture conditioning study*

Measurement	Ginning treatment[1]				
	Dried			Not dried, no moisture added	Significance level[2]
	No moisture restored	Moisture restored by—			
		Spray	Vapor		
Moisture content of lint entering 1st lint cleaner, *percent*	2.4	5.3	4.0	4.4	(**)
Card sliver:					
Fibrograph:					
Upper half mean length, *inch*	1.03	1.05	1.05	1.03	NS
Mean length, *inch*	.78	.80	.81	.78	NS
Uniformity ratio, *percent*	75	76	77	76	NS
Suter-Webb array:					
Upper quartile length, *inch*	1.14	1.18	1.18	1.15	(*)
Mean length, *inch*	.86	.91	.91	.87	(*)
Coefficient of variability, *percent*	40	37	37	39	(*)
Fibers shorter than ½-inch, *percent*	18.6	15.4	15.6	17.6	(*)
Pressley strength:					
0 gage, *grams per tex*	38.4	38.6	37.9	37.9	NS
1/8-inch gage, *grams per tex*	20.8	21.4	21.0	20.8	NS
Micronaire fineness, *reading*	4.6	4.6	4.6	4.6	NS
Spinning properties:					
Waste:					
Opening and picking waste, *percent*	.45	.42	.44	.41	NS
Card waste, *percent*	3.54	3.13	3.13	3.42	NS
Total picker and card waste, *percent*	3.97	3.54	3.55	3.82	NS
Neps of card web/100 sq. in., *number*	14	15	16	14	*
Yarn size obtained, *number*	38.8	38.4	38.1	38.3	NS
Break factor, *unit*	1,751	1,875	1,836	1,765	NS
Yarn appearance, *index*	102	104	104	102	NS
Ends down/1,000 spindle hours (corrected), *number*	68	50	47	77	NS
Yarn, single-strand evaluation and imperfections:					
Strength, *gram*	181.9	189.4	192.1	183.3	NS
Strength coefficient of variability, *percent*	11.6	11.1	11.6	12.1	NS
Elongation, *percent*	7.3	7.3	7.5	7.4	NS
Neps/1,000 yd., *number*	962	850	866	966	NS
Thick places/1,000 yd., *number*	2,195	1,764	1,798	2,151	(*)
Low places/1,000 yd., *number*	807	563	652	861	NS
Irregularity coefficient of variability, *percent*	25.0	23.6	23.5	24.6	NS

[1] See footnote 2, table 1, for description of ginning treatments.
[2] NS=not significant; *=significant at the 95-percent level; and **=significant at the 99-percent level.

d ends down can be associated with increased
n matter in the lint.[4]

linear correlation coefficients for the trash
lint and corrected ends down are positive
or 1961 and 0.49 for 1962 (table 9). The coef-
for both years grouped together is 0.71. The
sion curve for the foreign matter in the lint
ne corrected ends down for the two cottons
ned is shown in figure 4. Apparently, the
ions in ends down were due to variations in
ash.

correlation coefficients for the lint moisture
nts and the lint foreign matter contents are
or 1961 and −0.40 for 1962 (table 9). These
ients indicate a direct relationship among lint moisture, lint foreign matter content, and ends down for 1961, but this relationship is more obscure for 1962.

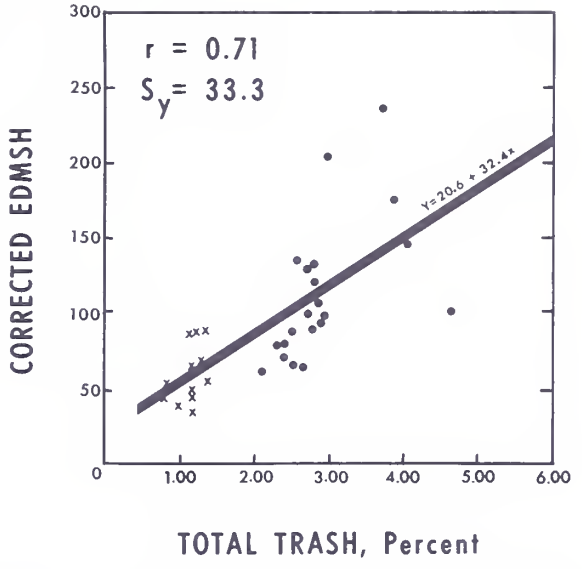

FIGURE 4.—Regression curve of the foreign matter in the lint and spinning corrected ends down for the 1961 (dots) and 1962 (x's) data combined.

VTON, FRANKLIN E., LAFERNEY, P. E., and BURLEY, L T., JR. THE EFFECTS OF TRASH ON COTTON PROC- PERFORMANCE AND PRODUCT QUALITY. 1965. Paper ed at the 1965 Cotton Research Clinic, Pinehurst, eb. 2–4, 1965; and NEWTON, FRANKLIN E., BURLEY, L T., JR., and MOORE, VERNON P. THE EFFECT OF REMOVAL ON COTTON PROCESSING PERFORMANCE AND T QUALITY. Textile Bul. 92 (3): 28–30, 75. 1966.

TABLE 9.—*Linear coefficients of correlation for selected sets of measurements, seed cotton moisture conditioning study, 1961 and 1962*

Variable	Correlation coefficient	
	1961	1962
Linear correlation between—		
Moisture content of lint entering 1st lint cleaner and		
Suter-Webb array (lint from bale):		
Upper quartile length	0.79	0.52
Mean length	.79	.47
Fibers shorter than ½-inch	−.76	−.48
Suter-Webb array (card sliver):		
Upper quartile length	.57	.59
Mean length	.66	.66
Fibers shorter than ½-inch	−.63	−.59
Moisture content of lint on the lint slide and		
Suter-Webb array (lint from bale):		
Upper quartile length	.83	.50
Mean length	.84	.43
Fibers shorter than ½-inch	−.82	−.44
Foreign matter content of lint from lint slide	.74	−.40
Foreign matter content of lint from lint slide and corrected ends down per 1,000 spindle hours	.54	.49

SUMMARY AND CONCLUSIONS

Two different methods, spray and vapor, of increasing the moisture content of seed cotton after cleaning but before ginning were tested to evaluate their effects on ginning operations, fiber and yarn quality, and spinning performance. The study was conducted over 2 crop years, 1961 and 1962.

Two cottons widely different in type, area of production, and method of harvest were used. Blightmaster variety grown on the High Plains of Texas and stripper-harvested was used in 1961, while Deltapine Smooth Leaf, produced in Arizona and harvested with a spindle-type picker, was used in 1962.

Seven moisture treatments were applied to the seed cotton at the ginnery in 1961 and four of these treatments were used the following year. The ginning equipment setup was held constant for all treatments and for both years.

The moisture treatments produced highly significant differences both years in moisture contents at all locations in the ginning process beyond the second 6-cylinder cleaner outlet. The lint moisture contents obtained by the treatments were highly correlated with fiber lengths and short fibers both in the ginned lint and in the card sliver in 1961 and similarly correlated, but at a lower level, in 1962. The correlation coefficients for moisture contents and fiber lengths were positive while those for moisture and short fibers were negative, indicating higher quality fiber with higher fiber moisture content at the time of ginning.

Seed cotton and lint cleaning efficiencies were affected very little by the treatments.

Pressley strength, micronaire fineness, and the color characteristics of cleaned lint were not affected by the treatments.

There was no change in Classer's grade in 1961, but the highest moisture content treatment in 1962 did result in a one grade reduction although it was not statistically significant.

Differences in mill waste with moisture treatments were significant in 1961 but not in 1962.

A highly significant trend towards higher yarn break factor with increased moisture content was obtained in 1961 but this was not statistically evident in 1962.

The ends down per 1,000 spindle hours were significantly different for treatments but erratic when compared with the moisture contents at the time of ginning. Other research indicated that the variation in ends down can be related more to trash in the lint than to moisture.

Both moisture-conditioning methods, spray and vapor, increased the fiber moisture content of the seed cotton immediately before ginning. Fiber and yarn qualities were associated with the amount of moisture in the fibers at the time of ginning but not with the method by which the moisture was obtained.

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